NONREIMBURSABLE MEMORANDUM OF UNDERSTANDING
BETWEEN
THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
AND NATIONAL SCIENCE FOUNDATION
FOR COLLABORATION ON SOLAR AND SPACE PHYSICS MODELING.

ARTICLE 1. AUTHORITY AND PARTIES

The National Aeronautics and Space Administration, located at 300 E Street SW, Washington, DC 20546 (hereinafter referred to as "NASA"), enters into this Memorandum of Understanding (hereinafter referred to as the "MOU") in accordance with the National Aeronautics and Space Act (51 U.S.C. § 20113(e)). The National Science Foundation, located at 2415 Eisenhower Ave., Alexandria, VA 22314 (hereinafter referred to as "NSF"), enters into this MOU in accordance with the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861 et seq.). NASA and NSF may be individually referred to as a "Party" and collectively referred to as the "Parties."

ARTICLE 2. PURPOSE AND IMPLEMENTATION

NSF and NASA have a long history of cooperative projects that have advanced the solar and space physics community. These projects include:

- the Community Coordinated Modeling Center (CCMC);
- Partnership in Collaborative Space Weather Modeling;
- joint implementation of the Theoretical and Computational Astrophysics Networks (TCAN) program; and
- coordination of citizen science activities.

The purpose of this MOU is to encourage and support interaction among NSF and NASA towards improved understanding of the coupled evolution of the magnetized solar atmosphere, the solar wind, and its interaction with the Earth's magnetosphere and upper atmosphere via integrated modeling of the essential physics and known observational characteristics. This MOU is intended to provide a structure through which NSF and NASA can coordinate the development of research activities in support of such integrated modeling in the US.

Further, this MOU advances the objectives of the National Space Weather Strategy and Action Plan, an effort aimed at enhancing national space-weather preparedness by coordinating, integrating, and expanding existing policy efforts; engaging a broad range of sectors; and collaborating with international counterparts.

Further, this MOU advances the objectives of the National Strategic Computing Initiative, an effort aimed at sustaining and enhancing the U.S. scientific, technological, and economic leadership position in High-Performance Computing research, development, and deployment.

Synopsis of the Program

Both NSF and NASA have a record of supporting investigator-initiated research projects aimed at physics-based modeling of individual elements of the Sun-Earth system submitted to their established

programs. Both Parties also agree that there is great potential for transformative research in the area of integrated modeling of the coupled evolution of the Sun-Earth system.

The specific objectives of this program to model the Sun-Earth system are:

- To produce an integrated model of the relevant multi-physics and multi-scale (both spatially and temporally) Sun-Earth system plasma phenomena that is computationally scalable and efficient on heterogeneous architectures.
- To interpret and assimilate observational information about the system from diverse and distributed data sources, including both sparse in-situ and remote image based line-integrated multi-wavelength data.
- To evaluate and propagate uncertainties associated with numerical solution of highly non-linear systems of partial differential equations in the presence of large numbers of model parameters, model uncertainty of the reduced physical description, and complex spatial discretization of the numerical representation of the Sun-Earth system.

ARTICLE 3. RESPONSIBILITIES

NSF and NASA will use reasonable efforts to perform the following:

A. *Solicitation Development*

1. The Parties will each identify one or more agency scientist(s) with the appropriate expertise to act as the point(s) of contact and lead Program Officer(s) (hereafter referred to as Principal Representatives) responsible for:
    a. the development of a joint solicitation aimed at developing improved methodology and software for predictive physics-based modeling of the coupled evolution of the Sun-Earth system,
    b. joint review of the proposals received in response to the solicitation,
    c. and the award recommendation process.
2. The Parties will develop the joint solicitation, provisionally titled "Next Generation Software for Data-driven Models of Space Weather with Quantified Uncertainties," which will describe the goals of the solicitation and the proposal submission and review processes.
3. The solicitation will be issued by NSF and posted on NSF and NASA websites, as well as Grants.gov.
4. NSF and NASA Principal Representatives will review and approve the relevant language in the solicitation before it is submitted for NSF clearance, and will also review and agree on any additional changes requested by NASA or NSF during clearance.
5. The joint solicitation shall mandate that each proposal submitted in response to the solicitation describes the software license for distribution of the software proposed to be developed by the proposing institution(s). The choice of a specific software license shall be justified in the proposal with emphasis on the sustainability of the software and subject to the following:
    a. The joint solicitation shall stipulate that software developed as a result of funding provided by awards made by the Parties in response to the solicitation is to be made available by the awardee free of charge for non-commercial use.
    b. The software license shall permit modification and redistribution of the software free of charge for non-commercial use.

B. *Proposal Submission, Review and Funding*

1. The NSF Directorate for Mathematical & Physical Sciences (MPS), in coordination with the NSF Directorate for Geosciences (GEO) and Directorate for Computer & Information Science & Engineering (CISE), will manage the submission and review of proposals submitted in response to the solicitation.
2. NSF will screen the proposals for applicant eligibility and compliance with the application process as specified in the solicitation.
3. Proposals will be evaluated in accordance with the standard NSF merit review criteria of intellectual merit and broader impacts, which are currently consistent with NASA's merit review criteria. The review will be conducted using the standard NSF merit review processes, including confidentiality policies, and NSF conflict of interest rules and procedures, including use of NSF Form 1230P for panel reviewers. Appendix A includes the NSF merit review criteria at the time of signing of this MOU. Should there be a change in the NSF merit review criteria, the Parties will jointly assess whether the criteria remain consistent with NASA's review criteria and adjust accordingly. Additional merit review criteria may be specified in the joint solicitation.
4. The process will include *ad hoc* reviewers, as needed, in combination with a review panel. The panel will provide a ranked list of proposals.
5. NSF is responsible for carrying out the review process. NASA plans to be involved in the review process in the following way: NASA Program Managers may recommend *ad hoc* and panel reviewers, assist in selection of reviewers, and may attend the review panel as observers. NSF retains final decision in selection of all reviewers and for compliance with Federal Advisory Committee Act (FACA). NASA will share in providing staff support needed for the review and other in-kind support, as necessary.
6. After the panel review has concluded, NSF and NASA Program Officers will meet to determine a mutually acceptable list of proposals to be recommended for selection.
7. For those proposals to be funded by NASA, NASA will request that the proposal's Principal Investigator submit to NASA a duplicate proposal with an identical Project Description and no factual changes to the proposal beyond the formatting changes required by NASA; for awards made by NASA in response to such proposals, NSF will provide all unattributed *ad hoc* and panel reviews of the original proposal to NASA Program Officers. The proposals resulting in awards funded solely by NASA will be administratively withdrawn from NSF.
8. Proposals funded by NSF in full or in part will remain within NSF.
9. Both NSF and NASA may commit up to $2,000,000 per year, each, for up to three years beginning in FY18 or FY19 to support selections made as a result of the joint solicitation, depending on the availiability of funds and the relevance and quality of proposals in the competition. This MOU does not commit the Parties to make awards up to any funding level or within any specific year.
10. Review analyses for declinations will be jointly drafted by Program Officers from NSF and NASA with final sign-off by NSF; NSF will be responsible for processing all declinations.

C. *Award Administration*
1. The Parties will each require its standard reporting requirements for its awards.
2. Post award grant administration will be pursuant to each Party's applicable regulations and/or policies.

ARTICLE 4. SCHEDULE AND MILESTONES

The planned major milestones for the activities defined in the "Responsibilities" Article are as follows:

Milestones for the FY 2018 – FY2020 Activity	**Due Date**
Joint NSF/NASA Solicitation Release Date	Within 60 days of MOU signed
Full Proposals submission deadline	90 days after solicitation release
Review complete of proposals	120 days after submission
Awards/Declines decisions	60 days after review complete

ARTICLE 5. FINANCIAL OBLIGATIONS

There will be no transfer of funds between the Parties under this MOU and each Party will fund its own participation. All activities under or pursuant to this MOU are subject to the availability of funds, and no provision of this MOU shall be interpreted to require obligation or payment of funds in violation of the Anti-Deficiency Act (31 U.S.C. § 1341).

ARTICLE 6. PRIORITY OF USE

Any schedule or milestone in this MOU is estimated based upon the Parties' current understanding of the projected availability of its respective goods, services, facilities, or equipment. In the event that either Party's projected availability changes, NASA or NSF, respectively, shall be given reasonable notice of that change, so that the schedule and milestones may be adjusted accordingly. The Parties agree that NASA's and NSF's use of its own goods, services, facilities, or equipment shall have priority over the use planned in this MOU.

ARTICLE 7. LIABILITY AND RISK OF LOSS

Each Party agrees to assume liability for its own risks arising from or related to activities conducted under this MOU.

ARTICLE 8. INTELLECTUAL PROPERTY RIGHTS - DATA RIGHTS

NASA and NSF agree that the information and data exchanged in furtherance of the activities under this MOU will be exchanged without use and disclosure restrictions unless required by national security regulations (e.g., classified information) or as otherwise provided in this MOU or agreed to by NASA and NSF for specifically identified information or data (e.g., information or data specifically marked with a restrictive notice).

ARTICLE 9. INTELLECTUAL PROPERTY RIGHTS - INVENTION AND PATENT RIGHTS

Unless otherwise agreed upon by NASA and NSF, custody and administration of inventions made (conceived or first actually reduced to practice) under this MOU will remain with the respective inventing Party. In the event an invention is made jointly by employees of the Parties (including by employees of a Party's contractors or subcontractors for which the U.S. Government has ownership), the Parties will consult and agree as to future actions toward establishment of patent protection for the invention.

ARTICLE 10. RELEASE OF GENERAL INFORMATION TO THE PUBLIC AND MEDIA

NASA or NSF may, consistent with Federal law and this MOU, release general information regarding its own participation in this MOU as desired. Insofar as participation of the other Party in this MOU is included in a public release, NASA and NSF will seek to consult with each other prior to any such release, consistent with the Parties' respective policies.

Pursuant to Section 841(d) of the NASA Transition Authorization Act of 2017, Public Law 115-10 (the "NTAA"), NASA is obligated to publicly disclose copies of all agreements conducted pursuant to NASA's 51 U.S.C. §20113(e) authority in a searchable format on the NASA website within 60 days after the agreement is signed by the Parties. The Parties acknowledge that, if this MOU is entered into pursuant to NASA's 51 U.S.C. §20113(e) authority, this MOU will be disclosed in accordance with the NTAA.

ARTICLE 11. TERM OF AGREEMENT

This MOU becomes effective upon the date of the last signature below ("Effective Date") and shall remain in effect until the completion of all obligations of both Parties hereto, or five (5) years from the effective date, whichever comes first.

ARTICLE 12. RIGHT TO TERMINATE

Either Party may unilaterally terminate this MOU by providing thirty (30) calendar days written notice to the other Party.

ARTICLE 13. CONTINUING OBLIGATIONS

The rights and obligations of the Parties that, by their nature, would continue beyond the expiration or termination of this MOU, e.g., "Liability and Risk of Loss" and "Intellectual Property Rights" and related clauses shall survive such expiration or termination of this MOU.

ARTICLE 14. POINTS OF CONTACT

The following personnel are designated as the Points of Contact between the Parties in the performance of this MOU.

Management Points of Contact

NASA
Terry Onsager
Science Mission Directorate
Heliophysics Division
300 E Street SW
Washington, DC 20546
Phone: 202.358.1615
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NSF
Vyacheslav S. Lukin
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2415 Eisenhower Ave.
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vipchaud@nsf.gov

ARTICLE 15. DISPUTE RESOLUTION

Should disagreement arise under this MOU, or amendments and/or revisions thereto, that cannot be resolved at the Division Director level, the area(s) of disagreement shall be stated in writing by each party and presented to the other party at the Assistant/Associate Director or equivalent level for consideration.

ARTICLE 16. MODIFICATIONS

Any modification to this MOU shall be executed, in writing, and signed by an authorized representative of NASA and the NSF.

ARTICLE 17. APPLICABLE LAW

U.S. Federal law governs this MOU for all purposes, including, but not limited to, determining the validity of the MOU, the meaning of its provisions, and the rights, obligations and remedies of the Parties.

ARTICLE 18. SIGNATORY AUTHORITY

Approved and authorized on behalf of each Party by:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

BY: _____

Thomas Zurbuchen
Associate Administrator
Science Mission Directorate

DATE: 4/30/18

NATIONAL SCIENCE FOUNDATION

BY: _____

Anne Kinney
Assistant Director
Directorate for Mathematical and Physical Sciences

DATE: 3-26-18

BY: _____

William E. Easterling
Assistant Director
Directorate for Geosciences

DATE: 3/27/18

BY: _____

James Kurose
Assistant Director
Directorate for Computer and Information Science and Engineering

DATE: 4/5/18

Appendix A

The following are the NSF Merit Review Criteria from the 2018 Proposal and Award and Policies and Procedures Guide which can be found at the following website:
https://www.nsf.gov/pubs/policydocs/pappg18_1/index.jsp

A. Merit Review Principles and Criteria

The National Science Foundation strives to invest in a robust and diverse portfolio of projects that creates new knowledge and enables breakthroughs in understanding across all areas of science and engineering research and education. To identify which projects to support, NSF relies on a merit review process that incorporates consideration of both the technical aspects of a proposed project and its potential to contribute more broadly to advancing NSF's mission "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes." NSF makes every effort to conduct a fair, competitive, transparent merit review process for the selection of projects.

1. Merit Review Principles

These principles are to be given due diligence by PIs and organizations when preparing proposals and managing projects, by reviewers when reading and evaluating proposals, and by NSF program staff when determining whether or not to recommend proposals for funding and while overseeing awards. Given that NSF is the primary Federal agency charged with nurturing and supporting excellence in basic research and education, the following three principles apply:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.
- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These broader impacts may be accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified.
- Meaningful assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher, more aggregated, level than the individual project. With respect to the third principle, even if assessment of Broader Impacts outcomes for particular projects is done at an aggregated level, PIs are expected to be accountable for carrying out the activities described in the funded project. Thus, individual projects should include clearly stated goals, specific descriptions of the activities that the PI intends to do, and a plan in place to document the outputs of those activities. These three merit review principles provide the basis for the merit review criteria, as well as a context within which the users of the criteria can better understand their intent.

2. Merit Review Criteria

All NSF proposals are evaluated through use of two National Science Board approved merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities. The two merit review criteria

are listed below. Both criteria are to be given full consideration during the review and decision-making processes; each criterion is necessary but neither, by itself, is sufficient. Therefore, proposers must fully address both criteria. Reviewers are strongly encouraged to review the criteria, including Chapter II.C.2.d(i), prior to the review of a proposal. When evaluating NSF proposals, reviewers will be asked to consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers will be asked to evaluate all proposals against two criteria:

- Intellectual Merit: The Intellectual Merit criterion encompasses the potential to advance knowledge; and
- Broader Impacts: The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to:
    a. Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
    b. Benefit society or advance desired societal outcomes (Broader Impacts)?
2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or organization to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?